Claims:

1. A process for separating a cell type from a mixture of cell types by electrophoresis comprising:

(a) providing a sample containing a mixture of cell types to a sample chamber of electrophoresis apparatus comprising a first electrolyte chamber; a second electrolyte chamber, a first sample chamber disposed between the first electrolyte chamber and the second electrolyte chamber; a second sample chamber disposed adjacent to the first sample chamber disposed and between the first electrolyte chamber and the second electrolyte chamber; a first ion-permeable barrier disposed between the first sample chamber and the second sample chamber; a second ion-permeable barrier disposed between the first electrolyte chamber and the first sample chamber; a third ion-permeable barrier disposed between the second sample chamber and the second electrolyte chamber; and electrodes disposed in the first and second electrolyte chambers; and

(b) applying an electric potential between the electrodes causing at least one cell type in the first sample chamber or the second sample chamber to move through the first ion-permeable barrier into the other of the first or second sample chamber.

2. The process according to claim 1 wherein the at least one cell type is selected from the group consisting of cancer, totipotent, multipotent, pluripotent, stem, viable, non-viable, bacterial, erythrocyte, leukocyte, bone marrow, organ, tissue, single cell eukaryote, prokaryote, algae, and plant.

3. The process according to claim 2 wherein the at least one cell type is selected from the group consisting of erythrocyte, leukocyte, bone marrow cell, organ cell, stem cell, and tissue cell.

4. The process according to any one of claims 1 to 3 wherein the sample contains at least two cell populations.

5. The process according to any one of claims 1 to 4 wherein the cell type of interest is caused to move out of the sample through the first ion-permeable barrier into the other of the first or second sample chamber and unwanted cell types remain in the sample during electrophoresis or the cell type of interest may remain in the sample and unwanted cell types are caused to move out of the sample into the other of the first or second sample chamber during electrophoresis.

6. The process according to any one of claims 1 to 5 wherein substantially all trans-barrier migration of a desired cell type occurs upon the application of the electric potential.

7. The process according to any one of claims 1 to 6 wherein the first ion-permeable barrier prevents substantial convective mixing of contents of the first and second sample chambers, the second ion-permeable barrier prevents substantial convective mixing of contents of the first electrolyte chamber and the first sample chamber, and the third ion-permeable barrier prevents substantial convective mixing of contents of the second electrolyte chamber and the second sample chamber.

8. The process according to any one of claims 1 to 7 wherein the step of applying an electric potential between the electrodes is maintained until at least one cell type reaches a desired purity level in the first or second sample chamber.

9. The process according to any one of claims 1 to 8 wherein the first ion-permeable barrier is a membrane having a characteristic average pore size and pore size distribution.

10. The process according to any one of claims 1 to 9 wherein all the ion-permeable barriers are membranes having a characteristic average pore size and pore size distribution.

11. The process according to claim 10 wherein at least some of the membranes are made from polyacrylamide and have a molecular mass cut-off of at least about 5 kDa.

12. The process according to claim 10 wherein the first barrier is a large pore sized membrane selected form the group consisting of polycarbonate membrane, polyacrylamide membrane, polyvinyl alcohol (PVA) membrane, polyethersulfone (PES) membrane, polyvinylidene fluoride (PVDF) membrane, nylon membrane, acrylic copolymer based membrane, vinyl coplymer based membrane, polysulfone membrane, cellulose membrane, cellulose triacetate membrane, cellulose esters, polypropylene membrane, silicates, borosilicate, and glass fiber.

13. The process according to claim 12 wherein the large pore size membrane is polycarbonate membrane.

14. The process according to claim 12 or 13 wherein the pore size is from 0.01 to 100 μm.

15. The process according to claim 14 wherein the pore size is from 1 to 10 μm.

16. The process according tc any one of claims 1 to 15 wherein the second and third barriers are restriction membranes having a molecular mass cut off less than that of the first barrier.

17. The process according to claim 16 wherein the restriction membranes are formed from polyacrylamide.

18. The process according to any one of claims 1 to 17 wherein at least about 50% of the at least one cell type remains viable or substantially unchanged after separation.

19. The process according to claim 18 wherein at least about 60%, more preferably at least about 70%, even more preferably at least about 80%, or up to about 90% of the at least one cell type remains viable or substantially unchanged after separation.

20. The process according to any one of claims 1 to 19 wherein the sample is processed in a static form in batches or processed in a substantially continuous form by moving the sample and electrolyte in streams through the apparatus.

21. The process according to any one of claims 1 to 20 wherein voltages range from about 1 to 200 V.

22. The process according to claim 21 wherein a voltage of about 60 V is used.

23. The process according to any one of claims 1 to 20 wherein field strengths of about 10 to 100V/cm are used.

24. The process according to claim 20 wherein a field strength of about 50 V/cm is used.

25. The process according to any one of claims 1 to 24 wherein electrophoresis run times ranging from about 1 to 60 minutes are used.

26. The process according to claim 25 wherein a electrophoresis run time of about 10 minutes is used.

27. The process according to any one of claims 1 to 26 wherein buffer or electrolyte concentrations are between 100 to 400 mM.

28. The process according to claim 27 wherein the buffer or electrolyte is selected from the group consisting of cell-compatible biological buffers and components such as HEPPS, HEPES, BisTris, sodium chloride, phosphate buffer salts, sucrose, glucose and mannitol.

29. The process according to any one of claims 1 to 28 wherein cell concentrations of between about 10^5 to 10^{10} are processed.

30. The process according to claim 29 wherein the cell concentrations are between 10^6 and 10^8.